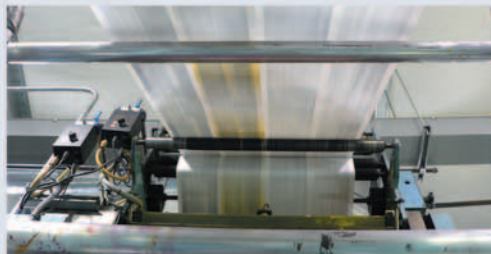
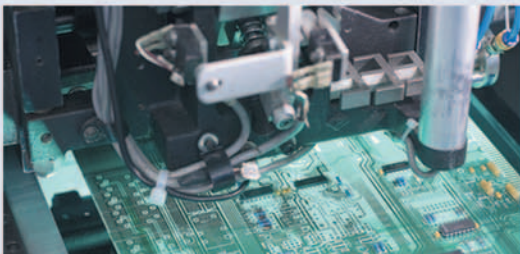


# Fumes to Fuel Technology

## VOC Abatement with a Payback



Convert your VOC emissions from an abatement issue to an asset. Climate Technologies' new Fumes-to-Fuel system can cleanly convert your VOC emissions to valuable electrical power.



# VOC Abatement and Energy Savings

## *Going beyond compliance.*

Volatile organic compounds (VOCs) are produced or released in a wide variety of industrial and commercial processes. Many of these substances are regulated and are contributors to the formation of petrochemical smog. Increasingly responsible attitudes toward environmental protection are resulting in new, stricter laws worldwide to reduce VOC emissions, such as those being implemented by the EPA and state and local authorities in the United States, the Ministry of Interior in Canada, TA Luft in Germany, and the UK's Environmental Protection Act. The cost impact of installing and operating the equipment necessary to meet these regulations, as well as the Kyoto Protocol, is being felt in many industries that deal with VOCs, such as:

- Paint Operations and Manufacturers
- Ethanol Production
- Chemical and Petrochemical Industries
- Oil Refining
- Printing Processes
- Pulp and Paper
- Adhesives and Resin Manufacturing
- Engineered Wood Products
- Coating and Laminating Operations
- Semiconductors and Electronics
- Fiberglass Product Manufacturing

Fortunately, Climate Technologies can now offer you new VOC abatement solutions that reduce your up front and operating costs, improve performance, and can even provide electricity and marketable greenhouse gas and emissions credits as byproducts.

## The State-of-the-Art in VOC Abatement

**Traditional VOC abatement systems** utilize the "capture and burn" method, whereby exhaust gas streams containing VOCs are incinerated in a thermal oxidizer or an RTO. In most cases VOCs are too dilute to sustain combustion on their own. In order to sustain combustion, significant amounts of natural gas need to be introduced into the thermal oxidizer or RTO, creating not only a significant fuel expense, but significant greenhouse gas emissions in the form of CO<sub>2</sub>.

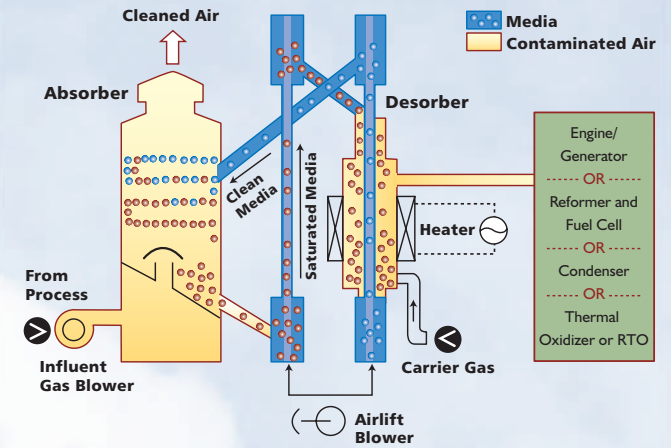
Fuel costs can be reduced by first directing the VOC-containing air stream through a concentrator, which increases the VOC concentration to 10 times its original level and thereby reduces the volume of



Ford's new Dearborn Truck Plant at the Rouge Center employs "Fumes-to-Fuel" technology to make electricity from paint fumes.



A "Fumes-to-Fuel" installation at Ford's Michigan Truck Plant in Wayne, Michigan. As contaminated process air passes through the fluidized bed's absorber, it is cleaned of its VOCs by the absorption media. When saturated, this media is transported to the desorber, where it is stripped of VOCs by heating it and passing a low volume of carrier gas through it. The resulting mixture of carrier gas and concentrated VOCs is then used directly as fuel in a Stirling engine to make electricity.



air/VOC stream sent to the regenerative thermal oxidizer by a factor of 10. This reduces the amount of natural gas needed by the thermal oxidizer or RTO, although this is partially offset by the fuel costs associated with creating a hot air stream needed for the concentrator to function. Traditional concentrator/RTO systems are effective at controlling VOCs but consume considerable amounts of energy, and their concentrating capability is limited to approximately 10:1.

### Climate Technologies' State-of-the-Art

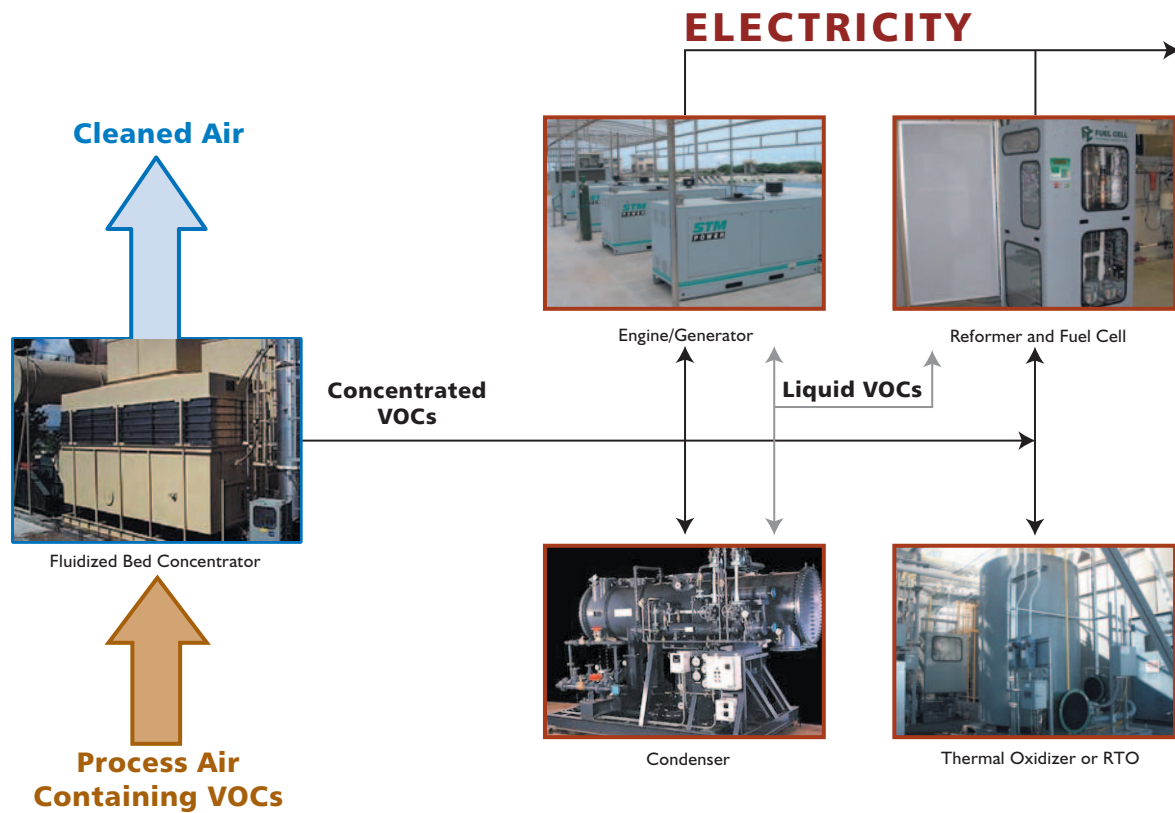
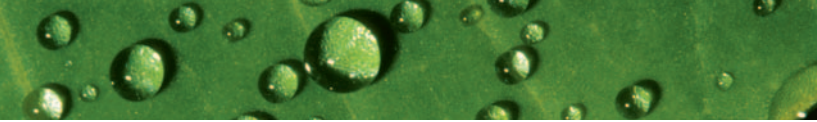
**Abatement System**, based on patent-pending "Fumes-to-Fuel" technology and winner of the Clean Air Excellence Award from the EPA, is available to reduce costs associated with compliance regulations and protecting the environment. The recognition that VOCs contain wasted energy and that traditional abatement systems consume considerable energy sparked the development of a new abatement technology based on using VOCs as the fuel to drive an electrical generator.

The system works in two stages. The first stage highly concentrates VOCs from the process exhaust, increasing the fuel value of the gas stream entering the second stage. The second stage uses the concentrated VOCs as fuel in an external combustion Stirling engine or internal combustion engine to produce electricity.

Optionally, a reformer device could be used to remove the hydrogen from the concentrated VOCs for use in a fuel cell, or the VOCs could be incinerated in a small thermal oxidizer or RTO. In order to sufficiently concentrate the VOCs for use as fuel, it was necessary to enhance the concentration capabilities from 10:1, typical of conventional carbon wheel concentrators, to 2,000:1 or more. Fluidized bed concentrators were adapted to this application.

## Advantages of the Climate Technologies System

- Significant Energy Savings.** When used in conjunction with an RTO, a Climate Technologies system can reduce your annual thermal energy consumption for VOC abatement by up to 80%, and when configured with power generation, by up to 95%. Per module (~50,000 cfm), the entire electrical energy consumption of your abatement system can be replaced by a net electrical surplus, which can be used to offset consumption elsewhere in your facility.
- Lower Initial Cost.** Compared to traditional concentrator/RTO abatement systems, the total installed cost of a Climate Technologies system could save you from 10% to 20%.
- Compact, Modular Design.** Depending on the composition of your VOCs, the Climate Technologies modular systems are designed to accommodate exhaust streams of up to 50,000 cfm each, and multiple modules can be operated in parallel for larger installations. The small footprint of these modules enables them to be located close to the VOC source(s) in your facility, further reducing installation costs. Custom modules to exactly match your situation are also available.
- Low Operating Costs.** Climate Technologies systems are designed for fully automatic operation to keep your manpower costs low, require minimal maintenance and are designed and built for high reliability.
- Lower Total Life-Cycle Costs.** The lower first cost, operating costs, and ongoing energy savings combine to give you the lowest possible total life-cycle cost. Benchmarking studies over a ten-year period show that the total life-cycle cost of a Climate Technologies system with power generation capability is only one-third that of a traditional concentrator/RTO system.
- Emissions Reductions.** Compared to traditional systems, VOC emissions can be reduced by 20-50%, and CO<sub>2</sub> emissions can be reduced by up to 90%. In some cases, these reductions in greenhouse gas emissions can be used to create valuable carbon credits.



## Make Climate Technologies Your Partner

Throughout its 35-year history, Climate Technologies Corporation has been a leader in providing advanced climate and environmental solutions to industry and commerce. We provide products that can help your company meet EPA requirements, and are the exclusive distributors worldwide for the combined VOC abatement and power generation systems known as "Fumes-to-Fuel." We at Climate Technologies can

expand your capabilities through quality products and responsive service. Climate Technologies Corporation provides turnkey solutions, systems integration and design services, project management, start-up services, and extended warranties for all equipment it provides. Project funding and leasing are available, or we can provide shared savings performance contract options to meet a wide variety of your needs.



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